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FORM PTO-1390 (REV 10-94) U.S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

DOCKET #: 3245-710PUS

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
09/462024

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE98/01633	15 June 1998	30 June 1997

TITLE OF INVENTION

Method and Device for Producing Thin Slabs

APPLICANT(S) FOR DO/EO/US

Werner RAHMFELD

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x]This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. [x]This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [x]A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x]A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [x]is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] has been transmitted by the International Bureau.
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [x]A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.
8. [] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [x]An UNEXECUTED oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. Below concern other document(s) or information included:

11. [] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [x]A **FIRST** preliminary amendment.
    [] A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. [] A substitute specification.
15. [] A change of power of attorney and/or address letter.
16. [x]Other items or information *(specify)*: PCT Publication Sheet, Int'l Preliminary Examination Report, Int'l Search Report in German and English translation, PCT Request, Letter with Proposed Drawing Changes

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U S APPLICATION NO (If known, see 37 C.F R 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/462024	PCT/DE98/01633	3245-710PUS

17.[x]The following fees are submitted:		
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO ..... **$840.00** International preliminary examination fee paid to USPTO (37 CFR 1.482)..... **$670.00** No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))..... **$760.00** Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... **$970.00** International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) **$96.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$840**	
Surcharge of **$130.00** for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	**$**	

Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =		x **$18.00**	**$**	
Independent Claims	2 - 3 =		x **$78.00**	$	
Multiple dependent claim(s) (if applicable)			+ **$260.00**	**$**	

TOTAL OF ABOVE CALCULATIONS =	**$840**	
Reduction of ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).	**$**	
SUBTOTAL =	**$840**	
Processing fee of **$130.00** for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +	**$**	
TOTAL NATIONAL FEE =	**$840**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	**$**	
TOTAL FEES ENCLOSED	$840	
Amount to be refunded:	**$**	
charged:	**$**	

a. [x] One check in the amount of $840 to cover the above fees is/are enclosed.
b. [] Please charge my Deposit Account No. 03-2412 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
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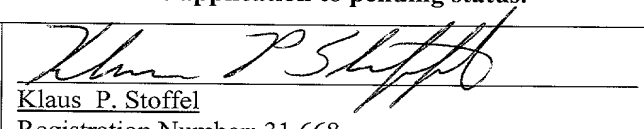

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By Express Mail # EL513860038US · December 30, 1999

Attorney Docket # 3245-710PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of
Werner RAHMFELD
International Appln. No.: PCT/DE98/01633
International Filing Date: 15 June 1998
For: Method and Device for Producing Thin Slabs

09462024 - 123099

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX PCT

S I R:

Prior to the issuance of a first Office Action and simultaneously with the filing of the present application, please amend said application as follows:

In the Specification:

Page 1, delete line 2;

after line 2, insert the following:

BACKGROUND OF THE INVENTION

Field of the Invention--;

line 7, delete ", and" and insert --. The invention further--;

after line 8, insert the following:

--Discussion of the Prior Art--;

line 9, prior to "DE" insert --German reference--;

line 12, delete ", in which" and insert --. In the--;

line 12, after "mold" insert --,--;

line 20, prior to "DE" insert --German reference--;

line 22, delete ", in which" and insert --. In this--;

line 22, after "is" insert --,--;

line 24, after "side" (first occurrence) insert --,--.

Page 2, line 7, delete ", in" and insert --. In--;

line 11, prior to "DE" insert --German reference--.

Page 3, after line 7, insert the following:

--SUMMARY OF THE INVENTION--;

delete lines 13, 14, 15 and 16 in their entirety.

Page 7, after line 2, insert the following:

--The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of the disclosure. For a better understanding of the invention, its operating advantages, and specific objects attained by its use, reference should be had to the drawing and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS--;

line 6, after "part" insert --;--;

line 8, after "parts" insert --;--;

line 10, after "apparatus" insert --;--;

line 12, after "apparatus" insert --; and--;

line 13, delete "Figure 5 shows" and insert --Figures 5a & 5b show--;

after line 14, insert the following:

--DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

Page 8, 13, after "represented" insert --which are mounted on bearings 47--.

Page 9, line 6, after "and a" insert --spade-shaped--;

line 11, delete "the figure" and insert --Figure 3--;

line 15, delete "the figure" and insert --Figure 3--.

Page 10, line 10, delete "the figure" and insert --Figure 4--;

line 12, delete "the figure" and insert --Figure 4--;

line 25, delete "the present figure" and insert --Figure 4--.

Page 11, line 4, delete "items 3 and 4 of" and insert --the 3rd and 4th set from--;

line 5, delete "framework" and insert --top--;

line 8, delete "items 5 and 6" and insert --the 5th and 6th sets--;

line 12, delete "Figure 5 shows" and insert --Figures 5a and 5b show--;

line 14, delete "the upper part of the illustration" and insert --Figure 5a--;

line 21, delete "the lower region" and insert --Figure 5b--.

Page 12, line 3, delete "The present diagram" and insert --Figure 5b--.

Please delete pages 19 and 20 in their entirety.

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In the Claims:

Please cancel claims 1-10, and add the following new claims:

--11. A process for producing a thin slab having broad faces with a predetermined convexity in a continuous casting installation, in which an immersion nozzle protrudes into a mold composed of broad and narrow faces followed by a strand guiding means for guiding the slab which comprises a strand shell surrounding a liquid sump, said process comprising the steps of:

a) forming broad faces of the strand shell to have planar surfaces in a region of the immersion nozzle which is shaped in the form of a spade, and simultaneously be parallel with respect to their contour lines;

b) outside a shadow region of the immersion nozzle, shaping said broad faces of the strand shell with planar surfaces that taper conically toward the narrow faces;

c) in a strand casting direction, feeding parts of the slab broad faces shaped with planar surfaces conically to each other up to a longitudinal extent of the mold of from 40 to 60 % to such a degree that lateral edges of the faces adapt themselves to ends of the planar parts of the slab broad faces tapering conically with respect to narrow faces of the slab;

d) joining wedge-shaped connecting pieces with the surface-like central parts of the slab broad faces with respective planar-surface edge parts of the slab broad faces; and

e) subsequently, in a mouth region and after leaving the mold, maintaining convexity formed by in each case three planar surface parts of the broad faces of the strand shell constant in its form as far as a lowest point of a liquid crater of the slab.

12. A process as defined in claim 11, including reducing slab thickness in a region of a strand guiding framework by only deforming the slab narrow faces.

13. A process as defined in claim 11, wherein the wedge-shaped connecting pieces between the planar slab central part, located in the shadow region of the immersion nozzle, and the slab broad-face parts tapering conically toward the narrow faces are given a form which encloses an angle $\alpha < 5°$ in a longitudinal extent o the slab central parts and represents a crowned surface which, having a central point of inflection, adjoins tangentially at its edges to two neighboring surfaces.

14. A continuous casting installation for producing a thin slab, comprising:

a laterally adjustable mold, the mold having broad side parts, narrow side parts, a large crowned cross-section on a charging side and a cross-section, opposite the crowned cross-section, on an strand outlet side which is smaller than the crowned cross-section and identically crowned in a central region;

an immersion nozzle that protrudes into the mold the immersion nozzle having a spade-shaped mouth with a maximum thickness (d) corresponding to d = 0.3 to 0.5 x D_E, where D_E is a distance between the mold broad face parts in the charging region, the broad-face parts having at least in a shadow region of the immersion nozzle central parts which are arranged parallel to one another according to their contour lines, the broad-face parts being formed, at least in an adjusting region of the narrow-face parts, as planar side surfaces, the planar side surfaces being movably arranged so that they move conically toward each other in a direction of the narrow face parts, the planar-surface central part being connected to the planar-surface side surfaces by transitional parts, the transitional parts tapering toward each other in a wedge form having a wedge tip that ends at a distance (a), measured from an upper edge of the mold, with a = 0.5 to 0.8 x L, where L = the length of the mold; and

pairs of supporting and guiding rollers which follow the mold and have a caliber adapted to an emerging crowned strand, the supporting and guiding rollers having a contour which corresponds to the planar-surface central plate and the planar side plates of the mold broad faces in a region of the mouth of the mold.

15. A continuous casting installation as defined in claim 14, wherein the central parts are planar surfaces which move conically toward each other in a strand conveying direction at an angle α, where α = 5 to 10° with α = 0.5 to 0.8 x L.

16. A continuous casting installation as defined in claim 14, wherein the central parts are shaped with planar surfaces in the shadow region of the immersion nozzle up to a = 0.5 to 0.8 x L and are arranged so as to be disposed parallel to one another, the mold further having connecting parts with contour lines, the connecting parts being parallel with respect to their contour lines and having in the strand conveying direction an S-shaped form with ends that respectively go over tangentially into a preceding and following part of the central part, the transitional parts being adapted to the connecting part in their longitudinal extent up to the wedge tip.

17. A continuous casting installation as defined in claim 14, wherein the transitional parts are shaped as a crowned surface, the crowned surface tangentially adjoining at one end a respective slab side part and at the other end the slab central part and having a central point of inflection.

18. A continuous casting installation as defined in claim 14, wherein the supporting and guiding rollers are split rollers having bearings provided in a region of the planar-surface central part.

19. A continuous casting installation as defined in claim 14, and further comprising rollers which are designed cylindrically in a central region and conically in side regions, with a diameter which enlarges outwardly so as to correspond to shaping of the slab.

20. A continuous casting installation as defined in claim 14, and further comprising means for cooling the transitional parts.--

In the Abstract:

Please cancel the present abstract and insert the following therefore:

--A process for producing thin slabs and a continuous casting installation for this purpose, having a laterally adjustable mold into which an immersion nozzle protrudes, and in which there is opposite a larger crowned cross-section on the charging side a cross-section on the strand outlet side which is small and identically crowned in the central region. The installation having pairs of supporting and guiding rollers which follow the mold and have a caliber adapted to the emerging crowned strand. The immersion nozzle has a spade-shaped mouth with a maximum thickness corresponding to d = 0.3 to 0.5 x D_E, where D_E is the distance between the mold broad faces in the charging region. The broad-face parts have, at least in the shadow region of the immersion nozzle, central parts which are arranged parallel to one another according to their contour lines. The broad-face plates are designed at least in the adjusting region of the narrow-face plates as planar side surfaces. The planar side surfaces are arranged so that they move conically toward each other in the direction of the narrow faces. The planar-surface central plate is connected to the planar-surface side surfaces by transitional parts. The transitional parts taper toward each other in the form of a wedge and the wedge tip ends at a distance (a), measured from the upper edge of the mold, with a = 0.5 to 0.8 x L, where L = the length of the mold. The supporting and guiding rollers have a contour which corresponds to the

planar-surface central plate and the planar side plates of the mold broad faces in the region of the mouth of the mold.--

REMARKS

The present amendment is being submitted prior to the issuance of a first Office Action and simultaneously with the filing of the present application.

With this amendment applicant has amended the specification, cancelled claims 1-10 and added new claims 11-20, all in an effort to place the application in better condition for examination.

Favorable action on the present application is respectfully requested.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,

COHEN, PONTANI, LIEBERMAN & PAVANE

By: _____

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30 December 1999

09/462024
428 Rec'd PCT/PTO 30 DEC 1999

TRANSLATION
from:

5/PRTS

71 851

Process and apparatus for producing thin slabs

Description

The invention relates to a process for producing thin slabs with a predetermined convexity of their broad faces in a continuous casting installation, in which an immersion nozzle protrudes into a mold followed by a strand guiding means, and relates to a corresponding apparatus for carrying out the process.

DE 41 31 828 C2 discloses a liquid-cooled width-adjustable plate mold for the continuous casting of strands of steel in slab format, in particular for a thickness of the slabs below 100 mm, in which plate mold the form of the broad-face plates at the strand outlet end of the mold corresponds to the strand format to be produced, the broad-face plates being designed as a planar surface in the adjusting region of the narrow-face plates.

This document does not give any suggestion that the strand format to be produced is also to have a convexity after leaving the mold.

DE 38 27 991 discloses an apparatus for continuously casting flat slabs, in particular a steel slab with a thickness below 80 mm, in which apparatus there is opposite the larger crowned cross section on the charging side a cross section on the strand outlet side of the mold which is smaller and identically crowned in the central

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WM. BERTSCHE, J.D., CH.E., A.C.S.
Founded in 1903 by
CARL V. BERTSCHE

region, and at least one roller of at least one pair of rollers of the supporting and guiding means following the mold has a caliber adapted to the emerging crowned strand.

The mold form known from this document as well as the form of the supporting and guiding means following the mold are designed in such a way that the mold has in the edge region a form adapted to the strand format, in other words there are already in the mold parallel side wall regions, which continue in the supporting and guiding rollers of the strand guiding framework.

DE 44 03 0 45 discloses a continuous casting installation for guiding strands of which the broad-face plates are made concave and the concavity is constant from the upper edge of the mold to the outlet of the mold and beyond to the last roller of the strand guiding means. The concave form in this case advantageously runs from the beginning of one narrow-face plate to the beginning of the other, opposite narrow-face plate.

The concave form of the broad-face plates known from this document concerns a relatively complicated form, which is influenced substantially by the flexure of the roller and the wear at the time.

The strand shell in the middle mold-width region, and consequently in the region of the pouring gate is disadvantageously subjected to a constant bending deformation

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as a consequence of the drawing-off movement until it leaves the region of the pouring gate.

In the documents cited, the graduation of the thickness-reduction steps with respect to the width profile of the strand is not clearly definable with respect to the strand thickness deformation with a liquid crater directly beneath the mold, the so-called cast rolling.

The object of the invention is to provide by simple constructional means a continuous casting apparatus having a mold and strand guiding rollers which reduce the loading on the strand shell and minimize the risk of longitudinal cracks and break-outs.

The invention achieves this object by the defining features of the process claim, claim 1, and the apparatus claim, claim 4. The subclaims show advantageous developments of the invention.

According to the invention, the broad faces of the mold are largely made up of planar surface parts and the strand guiding rollers have a contour which is made up substantially of straight lines. Right from the inlet of the mold there is provided in the central region a planar surface, which is maintained in the strand guiding direction and, beyond the mouth of the mold, is taken over completely by the central parts of the guiding rollers.

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On both sides of this planar central part there are likewise provided planar surfaces in the direction of the narrow faces. These planar surfaces are exactly maintained both in their form and in their inclination from the inlet of the mold up to the end of the strand guiding framework.

Between the planar central surface of the mold and the planar side surfaces arranged on both sides there are provided transitional pieces. The extent of these transitional pieces ends within the mold, with the result that the lower region corresponds to the strand format. In addition, this form allows simple introduction and delivery of the cold strand when starting up the continuous casting installation.

In an advantageous configuration, the central part is shaped with a planar surface in the charging region. The planar central parts of both broad faces of the slab run conically toward each other in the direction of the strand, until within the mold they are guided in parallel, forming a so-called crown, up to the mouth of the mold.

In a further advantageous configuration, the central parts are planar in their surface and disposed in parallel in the charging region and, outside the shadow region of the immersion nozzle in the strand guiding direction, are connected by a connecting part to the central part having the "crown" in the region of the mouth of the mold. The central parts have in this case a form of which the

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contour lines are parallel to one another and of which the longitudinal extent is designed in the form of an S in the strand conveying direction. The mouth of this S-form respectively goes over tangentially into the neighboring surfaces.

The slab produced in a mold according to the invention has broad faces which are made up of three planar surfaces, the side surfaces being conically shaped and the central surface being shaped with an elevation in comparison with the edge region. This form of slab makes better centering of the slab possible, especially with the strand drawing-off speeds customary nowadays. Uncontrolled movement of the strand in the mold and so-called snaking in the strand guiding framework are avoided as a result.

The outer form of the strand shell of the slab thus produced remains absolutely constant, at least as far as the lowest point of the liquid crater. The only change which the slab undergoes takes place in the direction of its thickness, only the narrow faces being deformed.

The middle mold-width region, to be precise the region designed as a trough, remains unchanged in its planar form until solidifying right through and ensures the most favorable lubricating conditions in the mold. The mold form according to the invention has the effect that the casting powder wets the surface of the strand with an amount which

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can be reliably predetermined in the region of the greatest susceptibility to longitudinal cracks. Thus, thanks to its planar form, the strand shell is not subjected to any bending stress favoring the occurrence of cracks close to the surface in this middle mold-width region.

The solidifying conditions of the strand shell are especially influenced in the region of the transitional parts and the connecting part by separate channelling of cooling media.

The following strand guiding framework has supporting and guiding rollers, which ensure reliable transporting of the slab still having a crater. According to the invention, various forms of roller are proposed, to be precise complete rollers or else split rollers.

In the case of the split rollers, use is made of simple cylindrical rollers which are adapted to one another according to the shaping of the central or side surfaces of the slab form predetermined by the mold.

Furthermore, it is proposed to divide the rollers in a ratio of 2/3 to 1/3, and to carry out this division alternately. In this case, the 2/3 roller has a contour corresponding to the assignment of the central part to the side part.

Depending on the slab width, in the case of smaller dimensions in particular, use may be made of complete

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rollers, which have as their contour the negative form of the lower part of the mold.

An example of the invention is presented in the attached drawing, in which:

Figure 1 shows a continuous casting mold with a constant central part

Figure 2 shows a continuous casting mold with constant side parts

Figure 3 shows a section through the continuous casting apparatus

Figure 4 shows a plan view of the continuous casting apparatus

Figure 5 shows a section through the strand guiding framework.

Figures 1 and 2 perspectively show a mold with a following strand guiding framework.

The mold has in this case broad faces 21, between which narrow faces 22 are clamped. The broad faces have a central surface 23, which is shaped with a planar surface and is disposed from the inlet up to the mouth of the mold.

In the charging region up to a length a, calculated from the inlet of the mold, the central parts are arranged parallel with one other with respect to their contour line

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and, overall, run conically toward one another in the strand conveying direction. In this region, the central parts 23 are connected to side parts 24 and 25 via transitional parts 26 and 27.

The transitional parts 26 and 27 are shaped in the form of wedges, the wedge tip 28 still within the mold being spaced apart from the mold inlet by the distance a.

At the narrow faces 22 there are provided adjusting elements 31, by which the narrow faces 22 clamped between the broad faces 21 are adjustable for changing the slab format.

Provided beneath the mold are supporting and guiding rollers 41. In the present example, split rollers 43-45, having a cylindrical form, are represented.

In Figure 1, the width of the central part 23 is denoted by b. In the present figure, the width b remains constant, beginning in the charging region of the mold and extending up to the mouth of the mold.

In the charging region, the side plates have a width f which, following the conical transitional part 26 or 27, widens to the width g and maintains this width constantly up to the mouth of the mold.

In Figure 2, in the charging region, the central plate has a width c which, following the wedge-shaped transitional parts 26, 27, widens to the width b in the strand casting direction up to the length a of the mold and,

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from there, remains constant up to the mouth of the mold.

In the case of this configuration, the width f of the side plates 24 and 25 remains constant over the entire length L of the mold.

An immersion nozzle 11, which has a tubular part 12 and a rectangular part 14, protrudes into the mold. The mouth 13 of the said immersion nozzle reaches under the level of the melt Sp (dashed line).

Figure 3 shows a section aa through the broad faces 21 of the mold.

Represented in the left-hand part of the figure is the planar-surface central plate 23, which at the distance a goes over into a straight region, disposed parallel to the opposite central plate.

In the right-hand part of the figure, a first portion of the central plate 23 has a planar surface and is disposed parallel to the center axis I. This parallel part is adjoined with a tangential transition by a connecting part 29, which has in section an S-shaped form and in turn goes over into the parallel part of the central plate 23 in the direction of the mouth.

In the inlet region, the spade-shaped part 14 of the immersion nozzle 11 protrudes into the mold, reaching under the level of the melt Sp.

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Represented beneath the mold are the supporting and guiding rollers 41.

The dashed line represents the distance D_s between the side plates 24 and 25, and consequently also the narrow face of the slab.

Represented in Figure 4 is a plan view of a mold broad face, together with the immersion nozzle 11 with its tubular part 12 and its rectangular part 14 and also the mouth 13, which reaches under the level of the melt Sp.

Represented in the right-hand part of the figure is the side plate 24, which has a constant width g.

Represented in the left-hand part of the figure is the side plate 25, which has in the inlet region of the mold a width f which, conically following the conical transitional part, has from the wedge tip 28 a width g.

The central plate 23 has with regard to the left-hand side of the figure a constant width b.

With regard to the right-hand side, the central plate 23 has a width c which widens in a way corresponding to the conical transitional part 26 and has from the wedge tip 28 the constant width b.

Represented beneath the mold are various rollers 43, 44.

Directly following the mold there are represented in the present figure a total of three rollers 43, 44, which

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respectively have a cylindrical form and are inclined toward one another in a way corresponding to the inclination of the sides and of the central surface of the slab produced.

The rollers, represented as items 3 and 4 of the framework, comprise a 2/3 roller 46 and a cylindrical roller 44. The roller 46 has a cylindrical portion and a conical part adapted to the inclination of the side surfaces.

Represented as items 5 and 6 are rollers of which the complete contour corresponds to the slab produced in the preceding mold, both in the central region and in the side regions.

Figure 5 shows a section through the guiding framework and the slab still having a crater in this region. Represented in the upper part of the illustration is the situation with the opposite pairs of rollers in the central region 43 and in the side regions 44, 45. These rollers support the broad faces 51 of the shell box made up of the broad faces 51 and the narrow faces 52. The shell box thereby envelopes the melt S, which forms in this region the crater within the slab.

Represented in the lower region is the situation with a complete roller 42, which has a cylindrical central part and conically enlarging side regions.

Also represented is a 2/3 roller 46, which supports the greater part of the slab broad face 51 and is adjoined in

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the right-hand part of the illustration by a cylindrical roller 44, which supports the narrow face region.

The present diagram clearly shows the slab having a "crown", which slab can be guided exactly through the strand guiding framework by the forms of rollers proposed here.

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Patent claims

1. A process for producing thin slabs with a predetermined convexity of their broad faces in a continuous casting installation, in which an immersion nozzle protrudes into a mold followed by a strand guiding means, said process having the following steps:

a) The broad faces of the strand shell are planar in their surfaces in the region of an immersion nozzle shaped in the form of a spade, and are at the same time parallel with respect to their contour lines, and

b) outside the shadow region of the immersion nozzle, said broad faces are shaped with planar surfaces and tapering conically toward the narrow faces;

c) in the strand casting direction, the parts of the slab broad faces shaped with planar surfaces are fed conically to each other up to a longitudinal extent of the mold of from 40 to 60 % to such a degree that their lateral edges adapt themselves to the ends of the planar parts of the slab broad faces tapering conically with respect to the narrow faces, and

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d) the wedge-shaped connecting pieces join up with the surface-like central parts of the slab broad faces with the respective planar-surface edge parts of the slab broad faces;

e) subsequently, in the mouth region and after leaving the mold, the convexity formed by in each case three planar surface parts of the broad faces of the strand shell is kept constant in its form as far as the lowest point of the liquid crater of the slab.

2. The process as claimed in claim 1, wherein, for reducing the thickness of the slab in the region of the strand guiding framework, only the slab narrow faces are deformed.

3. The process as claimed in claim 1, wherein the wedge-shaped transitions between the planar slab central part, located in the shadow region of the immersion nozzle, and the slab broad-face parts tapering conically toward the narrow faces are given a form which encloses an angle $\alpha < 5°$ in the longitudinal extents of the slab central parts and represents a crowned surface which, having a point of inflection in the center, adjoins tangentially at its edges to the two neighboring surfaces.

4. A continuous casting installation for producing thin slabs, having a laterally adjustable mold into which an

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immersion nozzle protrudes, and in which there is opposite a larger crowned cross section on the charging side a cross section on the strand outlet side which is small and identically crowned in the central region, and having pairs of supporting and guiding rollers which follow the mold and have a caliber adapted to the emerging crowned strand, for carrying out the process as claimed in claim 1, wherein

a) the immersion nozzle (11) has a spade-shaped mouth (13) with a maximum thickness (d) corresponding to d = 0.3 to 0.5 x D_E, where D_E is the distance between the mold broad faces (21) in the charging region,

b) the broad-face parts (21) have at least in the shadow region of the immersion nozzle (11) central parts (23) which are arranged parallel to one another according to their contour lines,

c) the broad-face plates (21) are designed at least in the adjusting region of the narrow-face plates (22) as planar side surfaces (24, 25),

d) the planar side surfaces (24, 25) are arranged such that they move conically toward each other in the direction of the narrow faces

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(22),

e) the planar-surface central plate (23) is connected to the planar-surface side surfaces (24, 25) by transitional parts (26, 27),

f) the transitional parts (26, 27) taper toward each other in the form of a wedge and the wedge tip (28) ends at a distance (a), measured from the upper edge of the mold, with a = 0.5 to 0.8 x L, where L = the length of the mold, and

g) the supporting and guiding rollers (41) have a contour which corresponds to the planar-surface central plate (23) and the planar side plates (24, 25) of the mold broad faces (21) in the region of the mouth of the mold.

5. The continuous casting installation as claimed in claim 4, wherein the central plates (23) are shaped as planar surfaces which move conically toward each other in the strand conveying direction at an angle α, where α = 5 to 10° with α = 0.5 to 0.8 x L.

6. The continuous casting installation as claimed in claim 4, wherein the central plates (23) are shaped with planar surfaces in the shadow region of the immersion nozzle (11) up to a = 0.5 to 0.8 x L and are arranged such that they are disposed parallel to one another, and wherein there are

provided connecting parts (29) which are parallel with respect to their contour lines and have in the strand conveying direction an S-shaped form, their ends respectively going over tangentially into the preceding and following part of the central plate (23) and their transitional parts (26, 27) being adapted to the connecting part (29) in their longitudinal extent up to the wedge tip (28).

7. The continuous casting installation as claimed in claim 4, wherein the transitional parts (26, 27) are shaped as a crowned surface, the crowned surface tangentially adjoining at one end the respective slab side plate (24, 25) and at the other end the slab central plate (23) and having a point of inflection in the center.

8. The continuous casting installation as claimed in claim 4, wherein the supporting and guiding rollers (41) are designed as split rollers (42-44), the respective bearings (47) being provided in the region of the planar-surface central plate (23).

9. The continuous casting installation as claimed in claim 4, wherein there are provided in the guiding framework, in a way corresponding to the shaping of the slab, rollers which are designed cylindrically in the central region and conically in the side regions, with a diameter which enlarges outwardly.

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10. The continuous casting installation as claimed in claims 4 or 7, wherein the transitional pieces (26, 27) are connected to a separate cooling means.

<u>List of items</u>

Feeding

11	Immersion nozzle
12	Tubular part
13	Spade-shaped mouth
14	Rectangular part

Mold means

21	Mold broad faces
22	Mold narrow faces
23	Central surface
24	First side surface
25	Second side surface
26	First transitional part
27	Second transitional part
28	Wedge tip
29	Connecting part

Adjusting means

31	Adjusting element

Guiding means

41	Supporting and guiding rollers
42	Convex roller

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43	Split roller, center
44	Split roller, first side
45	Split roller, second side
46	2/3 roller
47	Bearing
D_S	Distance between narrow faces
D_E	Greatest distance between broad faces
d	Thickness of immersion nozzle
S	Melt
Sp	Level of melt
B	Strand shell
L	Mold length
a	Distance from mold inlet
b	Constant width of central part
c	Width of central part in charging region
f	Width of side part in charging region
g	Constant width of side part
I	Center axis

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Abstract of the disclosure:

The invention relates to a process for producing thin slabs and to a continuous casting installation for this purpose, having a laterally adjustable mold into which an immersion nozzle protrudes, and in which there is opposite a larger crowned cross section on the charging side a cross section on the strand outlet side which is small and identically crowned in the central region, and having pairs of supporting and guiding rollers which follow the mold and have a caliber adapted to the emerging crowned strand. In this case,

a) the immersion nozzle (11) has a spade-shaped mouth (13) with a maximum thickness (d) corresponding to $d = 0.3$ to $0.5 \times D_E$, where D_E is the distance between the mold broad faces (21) in the charging region,

b) the broad-face parts (21) have at least in the shadow region of the immersion nozzle (11) central parts (23) which are arranged parallel to one another according to their contour lines,

c) the broad-face plates (21) are designed at least in the adjusting region of the narrow-face plates (22) as planar side surfaces (24, 25),

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d) the planar side surfaces (24, 25) are arranged such that they move conically toward each other in the direction of the narrow faces (22),

e) the planar-surface central plate (23) is connected to the planar-surface side surfaces (24, 25) by transitional parts (26, 27),

f) the transitional parts (26, 27) taper toward each other in the form of a wedge and the wedge tip (28) ends at a distance (a), measured from the upper edge of the mold, with a = 0.5 to 0.8 x L, where L = the length of the mold, and

g) the supporting and guiding rollers (41) have a contour which corresponds to the planar-surface central plate (23) and the planar side plates (24, 25) of the mold broad faces (21) in the region of the mouth of the mold.

Significant figure: Figure 1.

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Fig.1

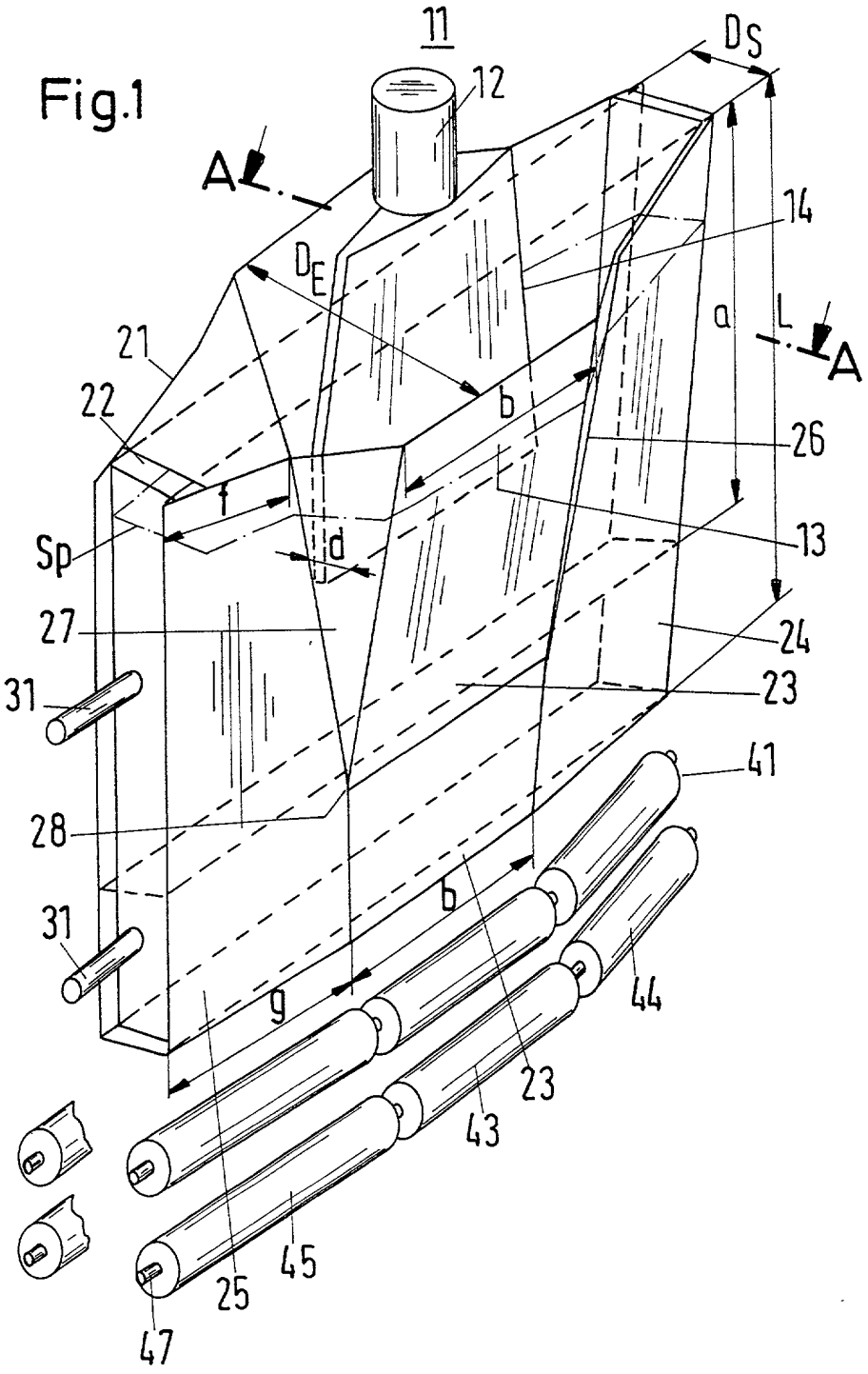
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Fig.2

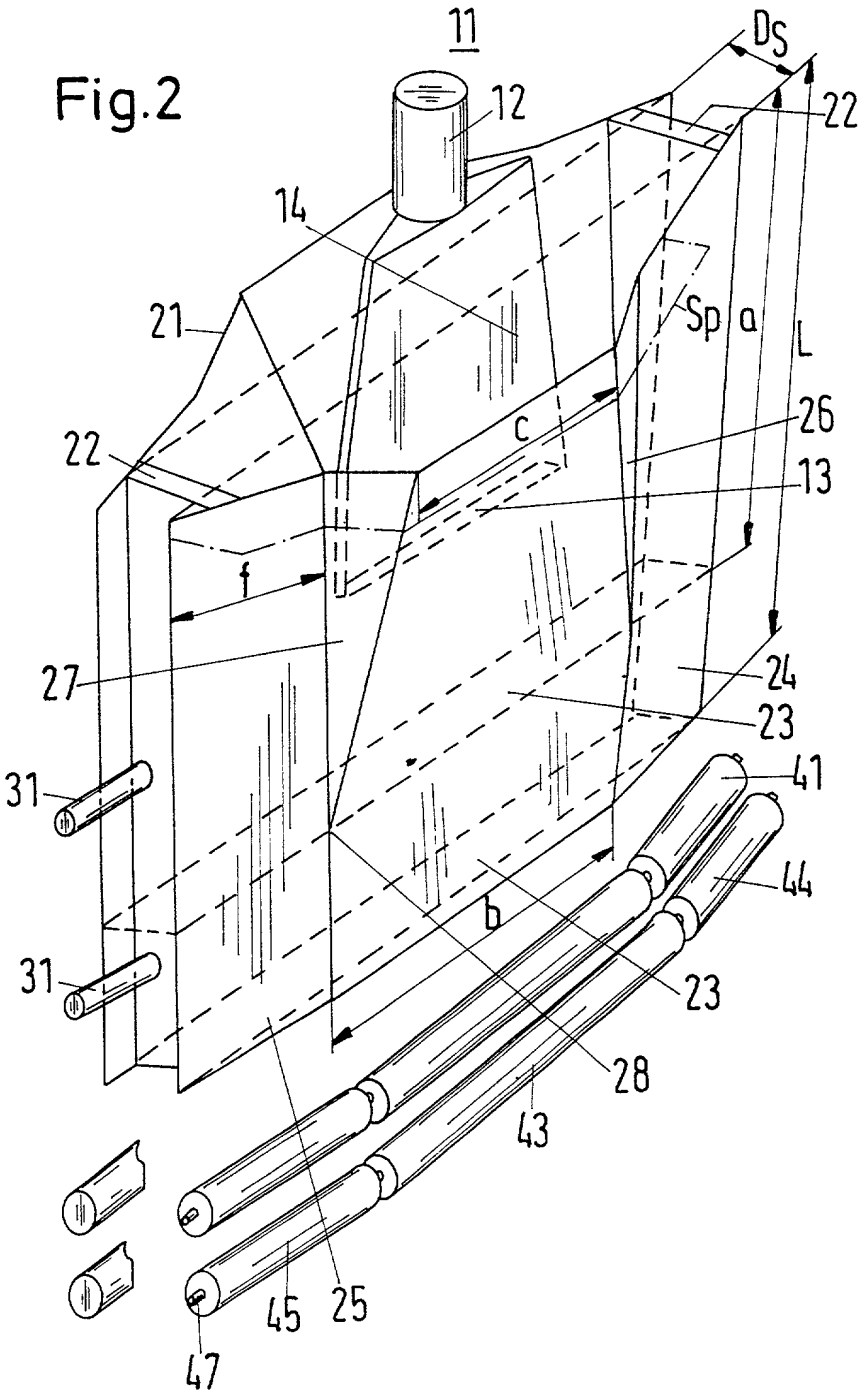
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Fig.3

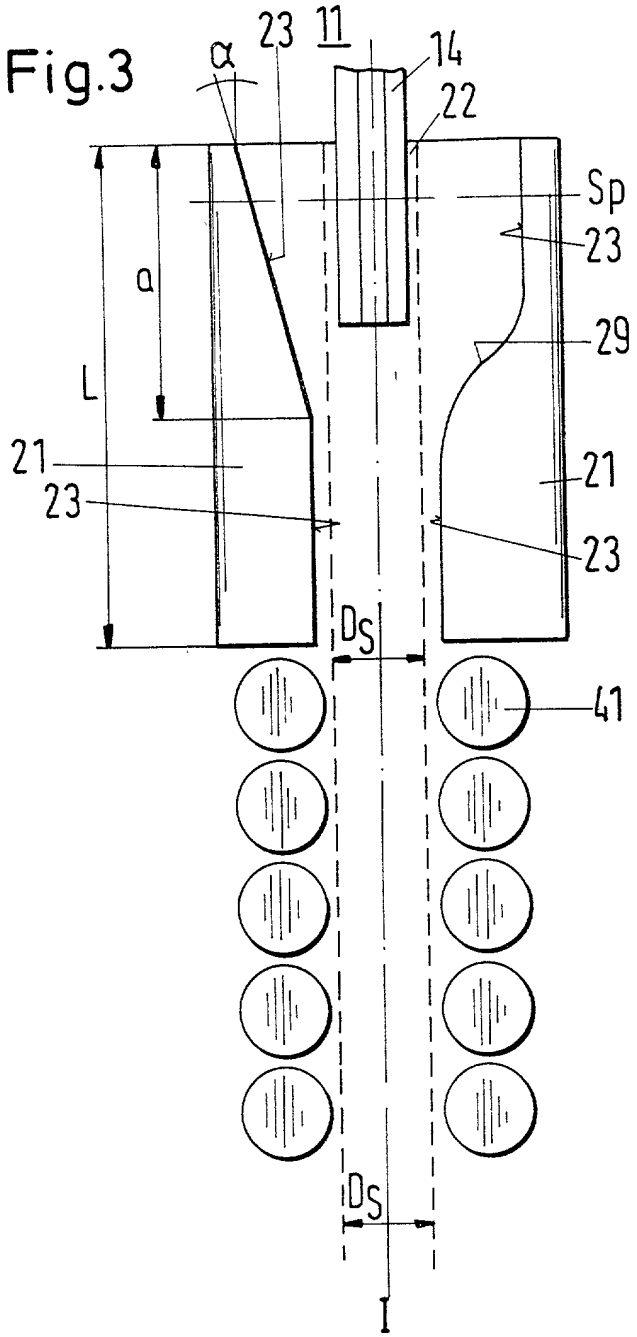

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Fig.4

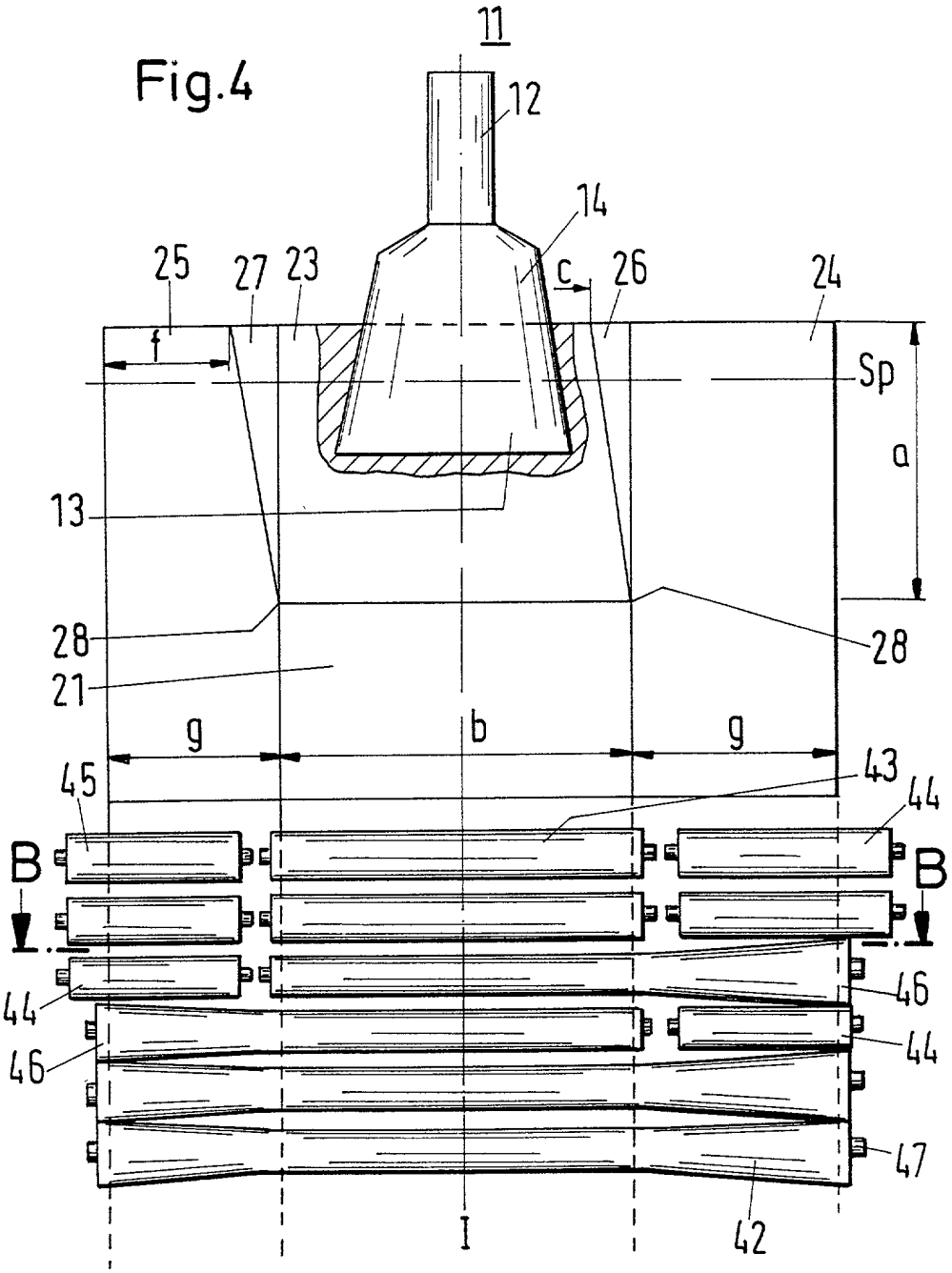
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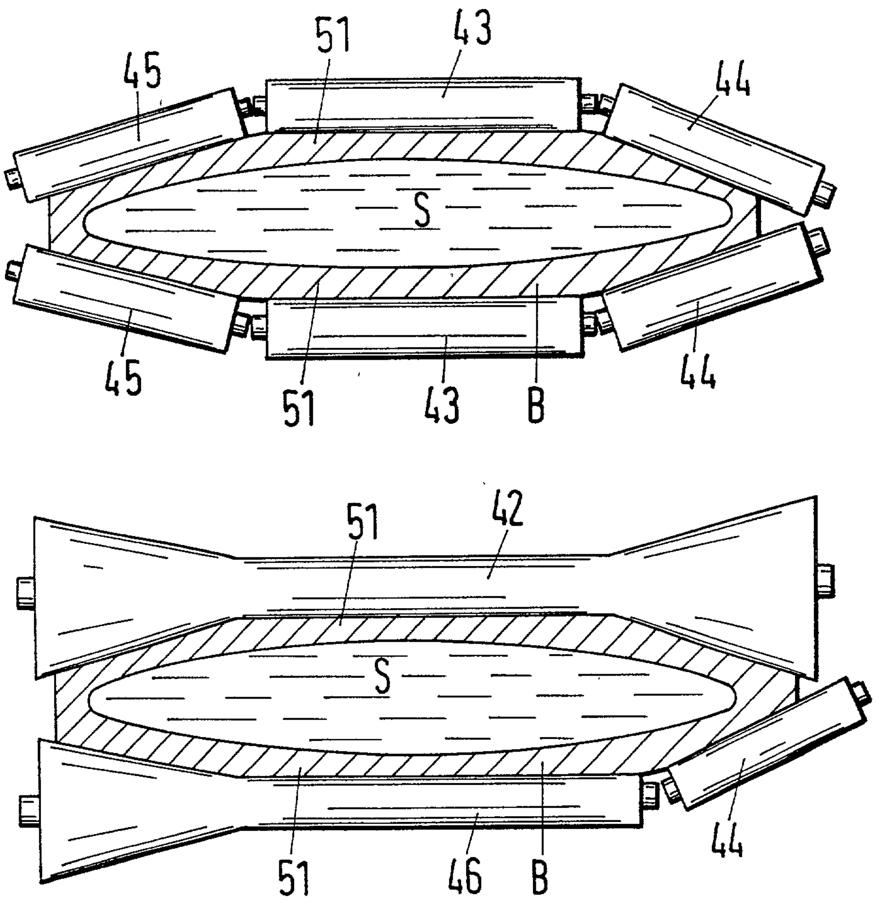
Fig. 5



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COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY Includes Reference to PCT International Applications	Attorney's Docket No.3245-710PUS

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND DEVICE FOR PRODUCING THIN SLABS

the specification of which (check only one item below)

[ ] is attached hereto

[ ] was filed as United States application

Serial No. _

on

and was amended

on _ (if applicable).

[x] was filed as PCT international application

Number PCT/DE98/01633

on 15 June 1998

and was amended under PCT Article 19

on (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

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Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Germany	197 28 957.6	30 June 1997	[x] YES	[ ] NO
PCT	PCT/DE98/01633	15 June 1998	[x] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO

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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

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U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED *(if any)*			
PCT/DE98/01633	15 June 1998				

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	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

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SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
Werner Rahmsfeld		
DATE Jan. 10, 2000	DATE	DATE

Docket #: 3245-710PUS